

WHAT IS CLAIMED IS:

1. A biodegradable material which contains biodegradable aliphatic polyester at not less than 95 wt% nor more than 99 wt% of a whole weight thereof and has a crosslinked structure in such a way that said biodegradable aliphatic polyester has a gel fraction percentage (gel fraction dried weight/initial dried weight) not less than 75% nor more than 95% to allow said biodegradable material to be heat-resistant.

2. The biodegradable material according to claim 1, wherein 1.2 to 5 wt% of a monomer having an allyl group is added to 100 wt% of said biodegradable aliphatic polyester.

3. The biodegradable material according to claim 1, wherein said biodegradable aliphatic polyester is polylactic acid; and said monomer having said allyl group consists of triallyl isocyanurate or triallyl cyanurate.

4. The biodegradable material according to claim 1, having a melting point of 150 to 200°C, a tensile strength at a high temperature in the neighborhood of said melting point is 20 to 100g/mm², and an expansion percentage of 100 to 30%.

5. A method for manufacturing a biodegradable material according to claim 1, wherein 1.2 to 3 wt% of a monomer having an allyl group and 100 wt% of a biodegradable aliphatic polyester are kneaded; an obtained uniform mixture is molded into a predetermined shape; said molded uniform

mixture is irradiated with ionizing radiation to generate a crosslinking reaction so that said biodegradable aliphatic polyester is crosslinked in such a way that a gel fraction percentage of said biodegradable aliphatic polyester is not
5 less than 75% nor more than 95%.

6. The method for manufacturing a biodegradable material according to claim 5, wherein an irradiation dose of said ionizing radiation is set to not less than 20 kGy nor more than 100 kGy.

10 7. A heat-resistant biodegradable material composed of biodegradable aliphatic polyester and a hydrophobic polysaccharide derivative are integrated with each other by crosslinking.

8. The biodegradable material according to claim 7,
15 having a structure crosslinked in such a way that a gel fraction percentage (gel fraction dried weight/initial dried weight) is 50% to 95%.

9. The biodegradable material according to claim 7, wherein said hydrophobic polysaccharide derivative has a
20 substitution degree of a hydroxyl group at not less than 2.0 nor more than 3.0; and not less than 5 wt% nor more than 30 wt% of said hydrophobic polysaccharide derivative is added to 100 wt% of said biodegradable aliphatic polyester.

10. The biodegradable material according to claim 7,
25 wherein not less than 0.5 wt% nor more than 3 wt% of a

crosslinking-type polyfunctional monomer is added to 100 wt% of said biodegradable aliphatic polyester.

11. The biodegradable material according to claim 10, wherein as said biodegradable aliphatic polyester, polylactic
5 acid or polybutylene succinate is used;

as said hydrophobic polysaccharide derivative, acetate ester starch, fatty acid ester starch or acetate ester cellulose is used; and

as said crosslinking-type polyfunctional monomer,
10 monomers having an allyl group such as triallyl isocyanurate, trimethallyl isocyanurate are used.

12. The biodegradable material according to claim 7, wherein a fusion molding temperature is set to a temperature range of 150°C to 200°C which is not less than a melting point
15 of said biodegradable aliphatic polyester and not less than a softening point of said hydrophobic polysaccharide derivative; a tensile strength of said biodegradable material at a high temperature in the vicinity of said temperature range is 30 to 70g/mm², and an expansion percentage of said
20 biodegradable material is 50 to 20% so that said biodegradable material is set low in said expansion percentage and high in said tensile strength.

13. A method for manufacturing a biodegradable material according to claim 7, wherein after biodegradable
25 aliphatic polyester, a hydrophobic polysaccharide derivative,

and a crosslinking-type polyfunctional monomer are mixed with one another at a temperature not less than a melting point of said biodegradable aliphatic polyester, said mixture is molded, and thereafter said molded material is irradiated
5 with ionizing radiation.

14. The method for manufacturing according to claim 13, wherein after 5 to 30 wt% of said hydrophobic polysaccharide derivative and 0.5 to 3 wt% of said crosslinking-type polyfunctional monomer are mixed with 100
10 wt% of said biodegradable aliphatic polyester, said mixture is molded, and thereafter said molded material is irradiated with ionizing radiation at 30 to 100 kGy.

15. A biodegradable material which is heat-shrinkable and composed of a mixture of biodegradable aliphatic
15 polyester and a low-concentration monomer having an allyl group, wherein in a state in which said mixture is crosslinked by irradiating said mixture with ionizing radiation or adding a chemical initiator to said mixture, said mixture is expanded with heat being applied thereto; and
20 wherein when said mixture is heated at a temperature not less than a temperature used at an expanding time, a shrinkage factor of said mixture is not less than 40% nor more than 80%.

16. The biodegradable material according to claim 15, wherein polylactic acid is used as said biodegradable
25 aliphatic polyester; a gel fraction percentage (gel fraction

dried weight/initial dried weight) thereof is not less than 10% nor more than 90%; a shrinkage factor at not more than 140°C is less than 10%, and said shrinkage factor at not less than 160°C is not less than 40% nor more than 80%.

5 17. A method for manufacturing a biodegradable material according to claim 15, wherein a crosslinking-type polyfunctional monomer is added at a low concentration to a biodegradable material and a mixture of said crosslinking-type polyfunctional monomer and said biodegradable material
10 is kneaded, and said mixture is molded into a predetermined shape;

 said mixture is irradiated with ionizing radiation to generate a crosslinking reaction so that a gel fraction percentage thereof is set to not less than 10% nor more than
15 90%; and

 said mixture is expanded while said mixture is being heated at a temperature not less than a fusing temperature of said biodegradable material nor more than a temperature obtained by an addition of said fusing temperature and 20°C
20 after said mixture is irradiated with said ionizing radiation to form said mixture as a heat-shrinkable material,

 wherein when said heat-shrinkable material is heated at a temperature not less than a temperature used at an expanding time, said heat-shrinkable material shrinks at a
25 shrinkage factor in a range of not less than 40% nor more

than 80%.

18. The method for manufacturing a biodegradable material according to claim 17, wherein a monomer having an allyl group is added at a low concentration to said
5 biodegradable aliphatic polyester, and a mixture of said crosslinking-type polyfunctional monomer and said biodegradable aliphatic polyester is kneaded, and said mixture is molded into a predetermined shape;

said mixture is irradiated with ionizing radiation at
10 not less than 1 kGy nor more than 150 kGy to generate a crosslinking reaction so that said mixture has a crosslinked structure and a gel fraction percentage (gel fraction dried weight/initial dried weight) thereof is not less than 10% nor more than 90%;

15 said mixture is expanded while said mixture is being heated in a range of 60°C to 200°C after said mixture is irradiated with said ionizing radiation to form a heat-shrinkable material,

wherein said heat-shrinkable material shrinks at a
20 shrinkage factor in a range of not less than 40% nor more than 80% when said heat-shrinkable material is heated at a temperature not less than a temperature used when said heat-shrinkable material is expanded.

19. The method for manufacturing a biodegradable
25 material according to claim 18, wherein polylactic acid is

used as said biodegradable aliphatic polyester, and not less than 0.7 nor more than 3.0 wt% of said monomer having said allyl group is added to 100 wt% of said polylactic acid, and said polylactic acid and said monomer having said allyl group
5 are kneaded;

said mixture is molded into a thin film, a thick sheet or a tube, and thereafter said thin film, said thick sheet or said tube is irradiated with ionizing radiation at not less than 5 kGy nor more than 50 kGy to generate a crosslinking
10 reaction so that said thin film, said thick sheet or said tube has a crosslinked structure and a gel fraction percentage thereof is set to not less than 50% nor more than 70%; and

after said crosslinked structure is formed, said thin
15 film, said thick sheet or said tube is heated at not less than 150°C nor more than 180°C to expand said thin film, said thick sheet or said tube at an expanding magnification of two to five.

20. The method for manufacturing a biodegradable
20 heat-shrinkable material according to claim 19, wherein triallyl isocyanurate is used as said monomer having said allyl group; an addition amount of said triallyl isocyanurate is set to not less than 0.7 wt% nor more than 2.0 wt% for 100 wt% of polylactic acid; after said mixture is molded, said
25 mixture is irradiated with electron beams at not less than 10

kGy nor more than 30 kGy; and said mixture is heated at not less than 160°C nor more than 180°C at said expanding time.

21. A biodegradable material, wherein a crosslinking-type polyfunctional monomer is added to a hydrophobic polysaccharide derivative to allow said biodegradable material to be crosslinked in such a way that a gel fraction percentage (gel fraction dried weight/initial dried weight) is 10 to 90%.

22. The biodegradable material according to claim 21, wherein 0.1 to 3 wt% of said crosslinking-type polyfunctional monomer is added to 100 wt% of said hydrophobic polysaccharide derivative; and a mixture is irradiated with ionizing radiation to allow said biodegradable material to have a crosslinked structure.

23. The biodegradable material according to claim 21, wherein a substitution degree of a hydroxyl group of said hydrophobic polysaccharide derivative is not less than 2.0 nor more than 3.0; and said hydrophobic polysaccharide derivative consists of one or a plurality of kinds of substances selected from among a starch derivative, cellulose derivative or Pullulan modified by etherified, esterified, alkylated or acetylated.

24. The biodegradable material according to claim 21, wherein said hydrophobic polysaccharide derivative consists of fatty acid ester starch, acetate ester starch, acetate

ester cellulose or acetylated Pullulan;

said polyfunctional monomer consists of triallyl isocyanurate (TAIC) or trimethallyl isocyanurate (TMAIC); and a gel fraction percentage is not less than 55%.

5 25. The biodegradable material according to claim 21, wherein said crosslinking-type polyfunctional monomer consists of a monomer having an allyl group selected from among triallyl isocyanurate (TAIC), trimethallyl isocyanurate (TMAIC), triallyl cyanurate (TAC), trimethallyl cyanurate
10 (TMAC); and

an acrylic monomer and a methacrylic monomer selected from among 1,6-hexanediol diacrylate (HDDA) and trimethylolpropane trimethacrylate (TMPT).

26. A method for manufacturing a biodegradable
15 material according to claim 21, wherein a crosslinking-type polyfunctional monomer is added to a hydrophobic polysaccharide derivative; and said crosslinking-type polyfunctional monomer and said hydrophobic polysaccharide derivative are kneaded; and after said mixture is molded into
20 a predetermined shape, said molded material is irradiated with ionizing radiation to generate a crosslinking reaction so that said biodegradable material has a crosslinked structure.

27. The method for manufacturing a biodegradable
25 material according to claim 26, wherein an irradiation dose

of said ionizing radiation is set to 2 to 50 kGy.